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A NEW METHOD OF INTESTINAL SURGERY.

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The following method of intestinal surgery was devised by me ten years ago.

At that time intestinal resection was in its infancy and surgeons had hardly begun to "feel for daylight" in this department of abdominal surgery. During the last few years the journals have teemed with discussion on this very important branch of conservative surgery.

Operation.

With thorough aseptic precautions make an incision in the median line of the abdomen, sufficiently long (exventration, if necessary) to enable you to thoroughly search the abdomen for the wounded or diseased portion of the gut.

Having found the part to be excised, bring it outside the abdomen with four to six inches of healthy gut on either side. Empty it of its contents by gently squeezing it between the fingers and thumb. Clamp the empty gut in two places from four to six inches above and below the portion to be excised. Pack well around with warm, large, flat aseptic sponges.

Lateral laparotomy should be performed in all operations on the appendix vermiformis, cæcum, or any part of the colon. Make an incision over the diseased or injured structure.

New clamp for bowel. Place a small flat sponge across the intestine, about four or six inches from the part to be excised, transfix the sponge and the mesentery close to the gut with a strong safety-pin. Pass the pin again through the sponge on the other side of the gut and clamp the pin, or better still, have *two* clamps prepared for immediate use with the sponges sewn firmly to the arched portion of the safety-pins. The sponge should be sufficiently large to compress the intestine against the pin, so as to effectually prevent extravasation of the contents.

The advantages are its extreme simplicity, its easy applicability, its innoxiousness, and its efficiency. The pressure can be regulated by the size of the sponge.

Neuber recommends a narrow elastic band to be passed through a small opening made in the mesentery, close to the intestine, at a suitable distance from each end of the piece of intestine to be removed, and tied around the gut to prevent the passage of feces and flatus. I have tried this method and found that the bowel may be injured by the ligature, no matter what care may be taken in applying it.

Sir William MacCormac, who wrote a paper on "Intra-peritoneal Injury" for the *Lancet*, May 7, 1887, says he has abandoned all artificial clamps and relies alone on the pressure of the fingers and thumbs of his assistants.

I believe an artificial clamp to be always necessary. An assistant's hands are often in the way and may relax long before the completion of a long operation.

SUTURE OF THE INTESTINE.

A wound in the longitudinal axis of the bowel may be easily sewn up with a continuous suture of chromicized catgut, fine silk, or carefully selected horsehair passed through the peritoneal and muscular coats.

A transverse section of the intestine should never be sewn up with a continuous suture, for the following reasons:

1. The diameter of the intestine is always varying.
2. As the stitches never cut out simultaneously, they would form loops inside the intestine, which would be liable to catch or be dragged, or torn out by the onward movement of the contents of the bowel.
3. A continuous suture might cause gangrene of the inverted circular margin of the cut ends of the bowel by uninterrupted strangulation of its coats.

The simple co-adaptation of peritoneal surfaces will not secure their firm adhesion by plastic lymph, but the irritation of the circumferential line of sutures causes a band of organizable plastic peritonitis which assures their ultimate permanent union.

Circular enterorrhaphy is a poser which requires some solving.

When the entire circumference of the gut is involved in the wound, the bowel must be invaginated so as to bring the encircling peritoneal surfaces into accurate juxtaposition all around, and suture them in that position.

How is this to be accomplished?

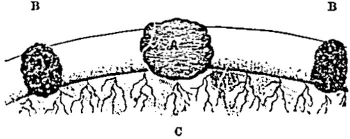
When Nature performs enterectomy successfully, she invaginates the upper portion of the intestine into the lower, and when the peritoneal surfaces around the neck of the invagination have united by adhesive inflammation, the intussusceptum or invaginated bowel sloughs off with impunity.

Several cases are recorded where five or six feet of the ileum have sloughed off in this way, and a case is recorded where a patient lived seven months after the successful excision by Nature of the cæcum, vermiform appendix, and six or seven feet of the ileum. Let us copy Nature as closely as possible when excising a diseased, gangrenous, or injured portion of the gut.

Apply torsion or ligature to the arteries separately as they are divided; this is to be preferred to tying the mesentery in sections with fine silk.

I will now, by a series of diagrams, endeavor to demonstrate the different stages and applications of this operation.

Diagram 1.



Jejuno-ileostomy or ileo-ileostomy.

A. Cancerous, gangrenous, or injured portion of the intestine. B, B. Sponges with safety-pins clamping the empty bowel four or five inches on either side of the diseased or injured structure. C, C. Mesentery.

Having cut off the cancerous, gangrenous, or injured portion of the intestine, bring together both ends of the bowel with two temporary sutures passed through *all the coats* of the intestine. The long ends of these sutures are left intact. One is placed at the mesenteric attachment of the gut and the other (exactly opposite) at the most distant portion of the bowel from the mesentery.

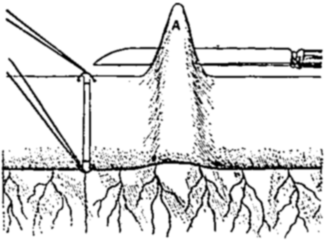
These temporary sutures are very important. They secure the complete peritoneal covering of the mesenteric attachment of both segments of the gut, help to maintain the proper relative position and accurate co-adaptation of the two cut ends, and facilitate their subsequent invagination through the opening made in the larger segment of gut.

Where enterectomy is performed for gangrene or injury, the lower or distal segment of the bowel is generally the largest; but where the operation is performed for stricture, cancer, or tumor pressing on or constricting the lumen of the gut, the upper or proximal portion is often much larger than the lower.

If you examine the gut in a living animal you will find that the bloodvessels pass into it from the mesenteric attachment. These divide and subdivide until they are lost in an invisible anastomosis in that portion of the intestine more distant from the mesentery.

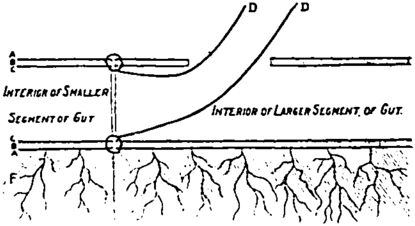
I propose to make an opening here in the larger segment of the gut, through which the invaginated ends of the divided bowel may be dragged by the long ends of the temporary sutures, and when they are accurately sewn together all around they may be pulled back into their normal position.

DIAGRAM 2.



A. Longitudinal section (about an inch and a half long) with tenotomy knife, of that portion of the larger segment of gut which is opposite to its mesenteric attachment. This opening should be made about an inch from the severed end of the larger segment of bowel; *its length depends* on the *size of the gut to be invaginated.* In performing this part of the operation, pinch up the coats of the intestine between the finger and thumb and divide with a tenotomy knife or pair of scissors.

DIAGRAM 3.

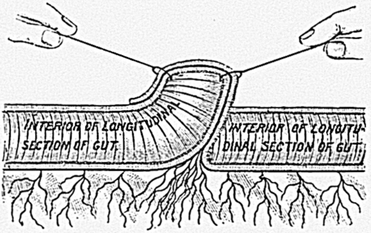

D
D
A
B
C
INTERIOR OF SMALLER SEGMENT OF GUT
INTERIOR OF LARGER SEGMENT OF GUT
C
B
A
F

Longitudinal section of gut, showing—A, A. Peritoneal coat. B, B. Muscular coat. C, C. Mucous coat. D, D. Temporary sutures passed into the bowel and out through the longitudinal slit made in larger segment of gut. F. Mesentery.

The edges of the longitudinal slit made in the bowel, which begins about an inch from its transverse section, should be well *turned in* and brought together with a continuous suture passed through the peritoneal and muscular coats only. It is a well-ascertained fact that a slight longitudinal contraction of the lumen of the bowel does not interfere with its physiological functions.

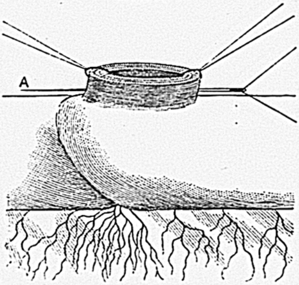
By this simple device, the perfect union by suture of a complete transverse section of the bowel, with its circumferential peritoneal surfaces in exact position and all the knots of the sutures on the inside, can be accomplished.

Diagram 4.


INTERIOR OF LONGITUDINAL SECTION OF GUT
INTERIOR OF LONGITUDINAL SECTION OF GUT

Longitudinal section of intestine, showing the relative position of the different layers of the bowel, invaginated at the longitudinal slit.

Diagram 5.



Invaginated gut, showing the two peritoneal surfaces in juxtaposition all around.
A. Needle passed through both sides of the bowel, including all the coats—introducing two sutures with one passage of the needle.

From diagram 4 it may be seen that the peritoneal surfaces are in accurate juxtaposition all around. While an assistant holds the ends of the temporary sutures, the surgeon passes a long, *fine*, straight needle, armed with a stout horsehair or *very fine* silkworm-gut through both sides of the bowel, taking a good grip (quarter of an inch) of all the the coats. The suture is then hooked up from the centre of the invaginated gut, divided, and tied on both sides. *In this way twenty sutures can be placed rapidly in position with ten passages of the needle.* (See diagram 5.) The temporary sutures are now cut off short and the sutured ends of the bowel painted with Woelfler's mixture of alcohol, glycerin, and colophony, and blown over with iodoform, the same that he applies to the surface of the raw stump after removal of the tongue. The bowel is then pulled back. The longitudinal slit in the gut is well turned in and closed with a continuous suture and painted with Woelfler's mixture and iodoform powder.

DIAGRAM 6.

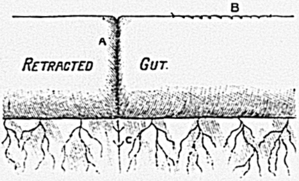


Diagram of retracted gut.

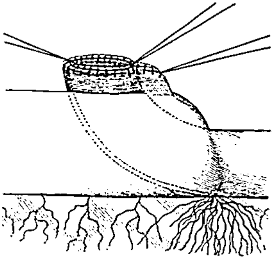
A. Line marking junction of both ends of bowel, the peritoneum well turned in, and the sutures and knots all inside the gut, making an almost invisible air- and water-tight joint. B. Longitudinal slit in bowel, sewn up with continuous suture. C. Sutures in the mesentery; seldom necessary to put more than one or two.

In all cases of obstruction from irreducible invagination, where rectal hydrogen inflation in the inverted position under chloroform has failed to reduce the intussusception, perform laparotomy. Having found the intussusception, first try uniform compression of the invaginated portion and gentle traction of the bowel in the usual way above the neck of the intussuscipiens. If this fails, instead of completely excising the intussuscipiens with the intussusceptum, as is generally advocated, or diverting the invaginated block from the physiological functions of digestion and assimilation in the manner so ingeniously devised by Professor Senn, of Chicago, proceed to resect the intussusceptum in the following manner:

Gently withdraw the intussusceptum until its neck appears outside the slit in the intussuscipiens. Transfix the base with two fine, straight needles armed with strong horsehair, chromicized gut, or fine silkworm-gut. Now amputate the intussusceptum a quarter of an inch clear of the needles so as to leave a fair stump beyond them. Transfixing the neck of the intussusceptum previous to its amputation *prevents it from flying back inside and insures the proper relative position of the different layers of the bowel* previous to sewing them up.

Having amputated the intussusceptum, pass the needles through and pick up the suture in the middle of the invaginated bowel, divide it, and suture the bowel on both sides; leave the ends of the four sutures long, so as to hold the cut ends of the bowel in position, until it is completely sutured up circumferentially. Now cut off the long ends of the sutures, apply Woelfler's mixture, blow over with iodoform, and withdraw the bowel. It now only remains to sew up the longitudinal slit with a continuous suture.

DIAGRAM 7.



Rough diagram showing acute irreducible invagination of the small intestine; longitudinal section.

Shows strangulation of the intussusceptum at the neck of the intussuscipiens. Circumferential peritoneal adhesive inflammation has taken place at this junction, causing constriction of the veins, and stasis, œdema, and gangrene commencing at the tip of the intussusceptum.

In three-fourths of the cases of intestinal obstructions occurring in children, invagination is the cause of the block. Treves says 30 per cent. of all cases of intestinal obstruction, exclusive of hernia, are due to invagination.

If there is a decided difference in the lumen of the segments of bowel to be united, put three temporary sutures through all the coats of the greater and lesser segments of the bowel, leave their ends long, taking care to accurately adapt the mesenteric arc or segment of the larger circle of bowel to the circumference of the smaller, by the first two sutures, leaving the third for the free cut end of the larger bowel most distant from its mesentery.

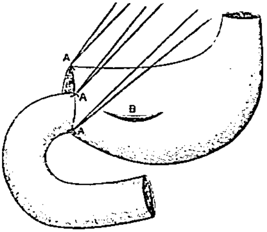
Invaginate the lesser into the larger segment and draw them out with the long sutures through a longitudinal slit made in the convexity of the larger bowel, one inch from its cut end.

When there is great disparity in the lumen of the two ends of the bowel, it is advisable to remove a small V-shaped portion from the convexity of the larger and round it off by suturing.

Now cut the sutures short and withdraw the invagination, and suture up the longitudinal slit in the usual manner.

GASTRO-PYLORECTOMY.—If the disease is confined to a *very small* portion of the pyloric end of the stomach, it may be excised completely as indicated in diagram 8.

DIAGRAM 8.



A, A, A. Temporary sutures, with ends intact, uniting cut surfaces of stomach and pylorus. B. Longitudinal slit in stomach, made by pinching up its coats between the finger and thumb, and transfixing with a tenotomy knife. Through this opening the invaginated cut ends of the pylorus and stomach are passed, when they can be sewn up from the inside, and then retracted to their normal position; the longitudinal slit being sewn up with a continuous suture.

On account of the normal semi-fixed condition of the greater portion of the duodenum, the application of this operation is limited to cases where there is only a small amount of disease confined to the pyloric end of the stomach.

When there is extensive disease of the pyloric end of the stomach and the upper portion of the duodenum, it may be deemed prudent for many reasons not to attempt the removal of the mass.

Under these conditions gastro-jejunostomy or gastro-intestinal anastomosis may be performed in the following manner:

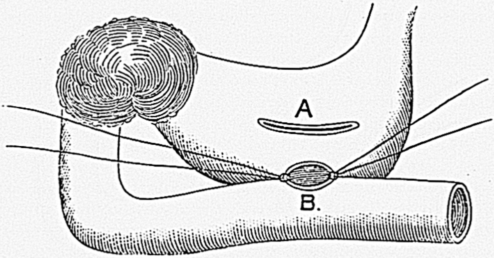
1. Draw out a portion of the jejunum as close as possible to the duodenum, empty it of its contents by gently squeezing it, and apply the sponge clamps in the usual manner.
2. Gently draw the greater curvature of the stomach into the wound.
3. Place the jejunum along the greater curvature of the stomach and proceed to unite them in whatever position they lie naturally, with least strain or kink.
4. The opening in the longitudinal axis of the jejunum should be slightly over an inch long and in that portion of the gut most distant from the mesentery. The corresponding opening in the stomach should be in the line of its greater curvature and one inch above it.

5. Unite the corresponding extreme ends of the wounds in the jejunum and stomach, with temporary sutures passed through the entire thickness of the walls of the stomach and jejunum, leaving the ends of the sutures long. Make an opening in the centre of the stomach sufficiently long to permit the *easy invagination* of the corresponding openings in the stomach and jejunum.

6. Having invaginated the two openings, sew them up all round as previously described, passing the needle through all the coats of the intestine and stomach.

7. Now retract the firmly approximated openings to their normal position, and sew up the longitudinal slit in the stomach with a continuous suture passed through its peritoneal and muscular coats.

DIAGRAM 9.



A large cancerous mass involving the pyloric end of the stomach and the upper part of the abdomen.

A. Opening in the centre of the stomach (where the vessels are very small) through which the corresponding openings (united by temporary sutures), B, made in the longitudinal axis of the upper end of the jejunum and in the line of the greater curvature of the stomach, may be invaginated and sutured round in the usual manner from the inside.

Withdraw invagination and sew up the slit in the centre of the stomach with a continuous suture.

When intestinal anastomosis is established, the portion of bowel cut off from the digestive functions has complete rest; active disease is often arrested, and it soon becomes atrophied.

The upper part of the jejunum is joined to the stomach an inch above its greater curvature.

The peritoneum is well turned in all round, and the sutures and knots all inside the stomach, making an almost invisible (from the outside) air- and water-tight junction.

The longitudinal slit in the centre of the stomach is sewn up from the outside with a continuous suture carefully passed through the serous and muscular coats.

Where the disease is located in the cæcum, ileo-cæcal valve, and appendix, one or other of the following operations may be performed:

ILEO-COLOSTOMY.—If the diseased cæcum, ileo-cæcal valve, and appendix cannot be safely excised owing to old-standing recurrent inflammation having firmly matted the bowel to the right ureter and the iliac vessels (as I have seen on several occasions), perform ileo-colostomy.

1. Empty the diseased cæcum and colon end of ileum.
2. Apply the sponge clamps to the healthy ileum and colon four inches off the disease.
3. Invaginate the cut end of the ileum attached to the cæcum and sew it up with a continuous suture.
4. Make a slit on the convex surface of the colon sufficiently long to just receive with very slight constriction the cut end of the ileum; secure with two temporary sutures, leaving the ends long.
5. Make a slit in the colon an inch higher up or an inch lower down in the cæcum, whichever is most convenient for the invagination.
6. Pass a dressing forceps through the slit and seize the two ends of the temporary sutures.
7. Drag the invaginated cut end of the ileum and its corresponding opening in the colon out through the slit.
8. Suture carefully all round and pull back to its normal position.
9. Sew up the longitudinal slit with a continuous suture.

ILEO-COLOTOMY.—Clamp the ileum and colon; completely excise the diseased cæcum and appendix.

Insert the cut end of the ileum into the healthy colon two inches above its cut end. Apply the two temporary sutures and invaginate them through the cut end of the colon; sew up all round. Withdraw the invagination. Finally close the cut end of the colon with a continuous suture, having invaginated it within itself to the extent of an inch.

ILEO-SIGMOIDOSTOMY.—This operation may be performed where the seat of obstruction is located low down in the colon near the sigmoid flexure. An artificial anus leaves a man in a loathsome condition, and should only be made in cases of obstruction from disease below the sigmoid flexure of the colon.

CONCLUDING REMARKS.

The simplicity of this operation and the universality of its applicability to all parts of the intestinal tract, may be taken as a measure of its perfection. It is the only operation as yet devised where rapid circular enterorrhaphy (the sutures passing through all the coats of the bowel, leaving the knots on the inside), can be accomplished.

Firmly suturing *all the coats* gives great healing capacity to the ends of the bowel, and the stitches are not likely to tear out.

The most important element of success, next to the efficiency of the operation, is its speedy performance.

After one has isolated the bowel to be resected with the sponge clamps, circular enterorrhaphy by the above method can be accomplished in ten minutes, which is less than half the time required for lateral apposition (intestinal anastomosis) with decalcified bone plates.

I find *this operation is especially easy in man,* for the coats of the bowel are thin and the lumen correspondingly large, so that invagination may be accomplished with marvellous ease. I have performed this operation successfully on very small dogs, where the coats of the bowel are very thick and muscular as compared with the lumen.

Professor Senn says: "I am convinced that circular enterorrhaphy, as it is *now* commonly performed, is attended by three great sources of danger:"

1. Perforation at the mesenteric junction not covered with peritoneum.
2. Length of time required in performing the operation.
3. Number of sutures required.

To obviate the danger of perforation at the junction of the bowel not covered by serous membrane, the temporary suture at the mesenteric attachment is passed through all the coats of the bowel previous to invagination and so *draws the peritoneum over the denuded space at the attachment of the mesentery.* This secures for the whole circumference of. the bowel a perfect peritoneal covering.

As to the *length of time required* for the operation, this is a most important consideration. Professor Senn says: "Even after I had acquired a fair degree of manual dexterity in suturing the bowel, I seldom spent less than an hour in making a circular enterorrhaphy with a double row of sutures."

The Czerny-Lembert method of suturing the bowel causes great delay, as the surgeon has to pick up carefully the peritoneal and muscular coats of the bowel, thirty or forty times, *if possible,* without perforating the mucous coat. Lastly, the double line of sutures may cause gangrene between the stitches.

In the operation I advocate there is no necessity to apply Nothnagel's test to determine the direction in which the invagination should be made. In circular enterorrhaphy with the aid of a rubber ring as recommended by Professor Senn, it is necessary to find which is the afferent and which is the efferent part of the tube, so as to make the invagination in the right direction.

In practice the proximal is often the largest end of the bowel, which renders it very difficult and often impossible to force it into the distal end.

I have seen Nothnagel's test signally fail. I need say no more in condemnation of this operation.

Professor Senn has done much to advance intestinal surgery. His method of intestinal anastomosis by decalcified plates is ingenious, but I refuse to accept it as the right method, for it is clumsy and unsurgeonlike.

The mere approximation of the *vis a-vis* openings in the plates by *four sutures* is often successful in the dog, where the coats of the bowel are very thick and muscular as compared with the lumen. In man the coats of the bowel are very thin as compared with the lumen, and it is always necessary to apply a continuous line of sutures through the peritoneal and muscular coats, both behind and in front of the plates. These additional or supplementary sutures necessarily prolong and seriously complicate the operation.

Before performing any operation on the bowels, it is advisable to irrigate the stomach and rectum with hot water. It prevents sickness and flatulence after the chloroform.

In flushing the abdominal cavity with sterilized hot water, it is advisable to place a tube in each loin, as recommended by Mr. Barker, of University College Hospital.

In searching for a diseased or injured portion of the gut, time is often saved by making a very large incision, so that the lesion can be seen as well as felt.

Mechanical control of the bowels. In performing exventration or extensive laparotomy many contrivances are adopted to keep the bowels backward toward the spine and upward or downward, as the case may be. How is this to be done? Sponges only fill the abdomen and do not retain the omentum and intestines in the position most convenient for the operator. Assistants' hands occupy too much room and are often in the way.

I find the following device very simple and efficient:

Make three strong copper-wire frames, four, five, and six inches square. These three sizes are quite sufficient for all cases of exventration. A few minutes before operating cover them with three- or four-ply of aseptic gauze, and sew it firmly to the framework. Fasten a strong eighteen-inch suture with a straight needle attached to each corner of the framework.

When one has performed an extensive laparotomy and found the bowel lesion, pass in a suitably sized frame covered with gauze and bend it, so as to keep the bowels in the required position. To retain it in this position pass the sutures from within outward on the outside of the quadratus lumborum and fasten them with a stiff rubber sliding clip, or, better still, to a wire retractor holding back the edges of the wound. In some cases it is only necessary to fix one suture on either side.

This method—with the sutures fastened to the wire retractors—

1. Gives a fine view of the lesion to be operated on.
2. Insures the bowels being kept warm and out of sight from the beginning of the operation until the end.
3. Is extremely simple and efficacious.

Operative surgery being a purely mechanical science, it is best taught by a series of diagrams with explanatory notes.

The education of the surgeon is too much of the book—bookish. No man should pose as a surgeon unless he has had some mechanical training. As a boy, he should be taught to use a needle and thread, carving tools, and to draw, so that the hand may work in unison with the brain.

Sutures for the bowel. Fine silk is recommended in all text-books for sewing up the gut.

I find horsehair or fine silkworm-gut far the best.

Silk sutures, when wet, are very sloppy to work with. They swell up and often cause suppuration in their track, and so may become the seat of perforation.

None of these disadvantages apply to horsehair or fine silkworm-gut. Horsehairs, if carefully selected, make the best sutures. They should be taken from the tails of large draft-horses.

The hair from the mare's tail is unreliable, as it is often rotten from the urine.

Carefully select all the longest and strongest hairs, *without a flaw in them,* tie them together at one end and have them well brushed in soap and water. Put them to soak in a bichloride solution (1:4000) for two or three hours. Shake them out and place in a large glass-stoppered bottle, where they may be kept clean and free from dust. Before using the hair leave it soaking for two or three hours in water (bichloride solution, 1:5000)—it *makes the hair pliable* so that it may be tied in a firm, fast knot without fear of cracking. This fact is well known to all fly-fishers, who put their silkworm-gut to soak in water a few hours before using it.

I find that nearly all the horsehair used in the London hospitals is rotten. If not brittle when first obtained, it becomes so by being kept in water for months before using. Silkworm or salmon gut will become brittle under the same condition.